Charles University

Faculty of Physical Education and Sport

Department of Physiotherapy

BACHELOR THESIS:

"Osteoarthritis, total knee replacement and its rehabilitation."

Øystein Grønnevik, April 2008, Prague.

I. Abstract.

Name of the Bachelor thesis: "Osteoarthritis, total knee replacement and its rehabilitation."

Aim: The thesis will look into the topics of osteoarthrosis, total knee replacement and its rehabilitation, and involve a detailed physiotherapeutic record of two weeks of rehabilitation.

Clinical Findings: The patient is a 77 year old retired woman after a non-cemented non-constrained total knee replacement l. dx. due to osteoarthrosis. Initial Kinesiological Examination revealed hypertonus and shortness of rectus femoris , shortness of sartorius, weak gluteus maximus and hamstrings, all bilateral findings, pain in the hip and TrP of gluteus medius left side (patient had a total hip replacement l. sin. 7 years ago), and a ROM of right knee from -5-80° in the frontal plane.

Methods: The rehabilitation took place once before lunch time and once after lunch time from Tuesday to Friday the first week, and from Monday to Friday the second week. The very first meeting with the patient was an Initial Kinesiological Examination and the very last meeting was the Final Kinesiological Examination. Various methods of strengthening targeted weak muscles was used, including implementation of TheraBands, and stretching of short and/or hypertonic muscles by PIR according to Lewit.

Results: Strengthening exercises helped improve verticalisation during gait, and stretching increased the ROM in the right knee in the frontal plane from -5-80° to 0-110.

Key words: Osteoarthrosis, total knee replacement, PIR.

II. Declaration.

I declare that this Bachelor Thesis has been based entirely on my own individual work and on my own practice that took place Revmatologicky Ustav in Prague from Monday the 4th of February 2008, to Friday the 15th of February 2008.

All the information used for the development of this Bachelor Thesis has been taken from the list of literature that exists in the end of this Thesis.

Prague, 2008

Øystein Grønnevik

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1. Preface.

As a third and final year student of Physiotherapy at the Faculty of Physical Education and Sports, Charles University, Prague, 2008, we are obliged to undergo a two-week practice at a clinic that offers physiotherapy to its patients. On the basis of these two weeks of practice, we are to write a so-called Bachelor Thesis. This is my Bachelor Thesis.

My practice lasted from Monday the 4th of February 2008, to Friday the 15th of February 2008. During that time I had 18 meetings with one patient; two meetings with the patient every day (excluding Saturday and Sunday), including the last day of my practice, Friday the 15th of February.

My practice was held at Revmatologicky Ustav at Albertov, Prague.

2. Acknowledgements.

I would like to thank my friend and fellow student, Martin Andreas Bøkestad, that had to listen to me whine when things didn't go as I planned them, and helped me when I needed it.

However, this thesis could not have been made without my supervisor, Mgr. Jirina Holubarova. Her sound advice made this thesis into what it is. I am very grateful for this.

3. List of Abbreviations.

ABD: abduction.

ADD: adduction.

CMC: carpometacarpal.

CMT: carpometatarsal.

CPM: continual passive motion.

DF: dorsiflexion.

DIP: distal interphalangeal.

dx: dexter; right.

E: extension.

ER: external rotation.

F: flexion.

IR: internal rotation.

OA: osteoarthritis.

PF: plantarflexion.

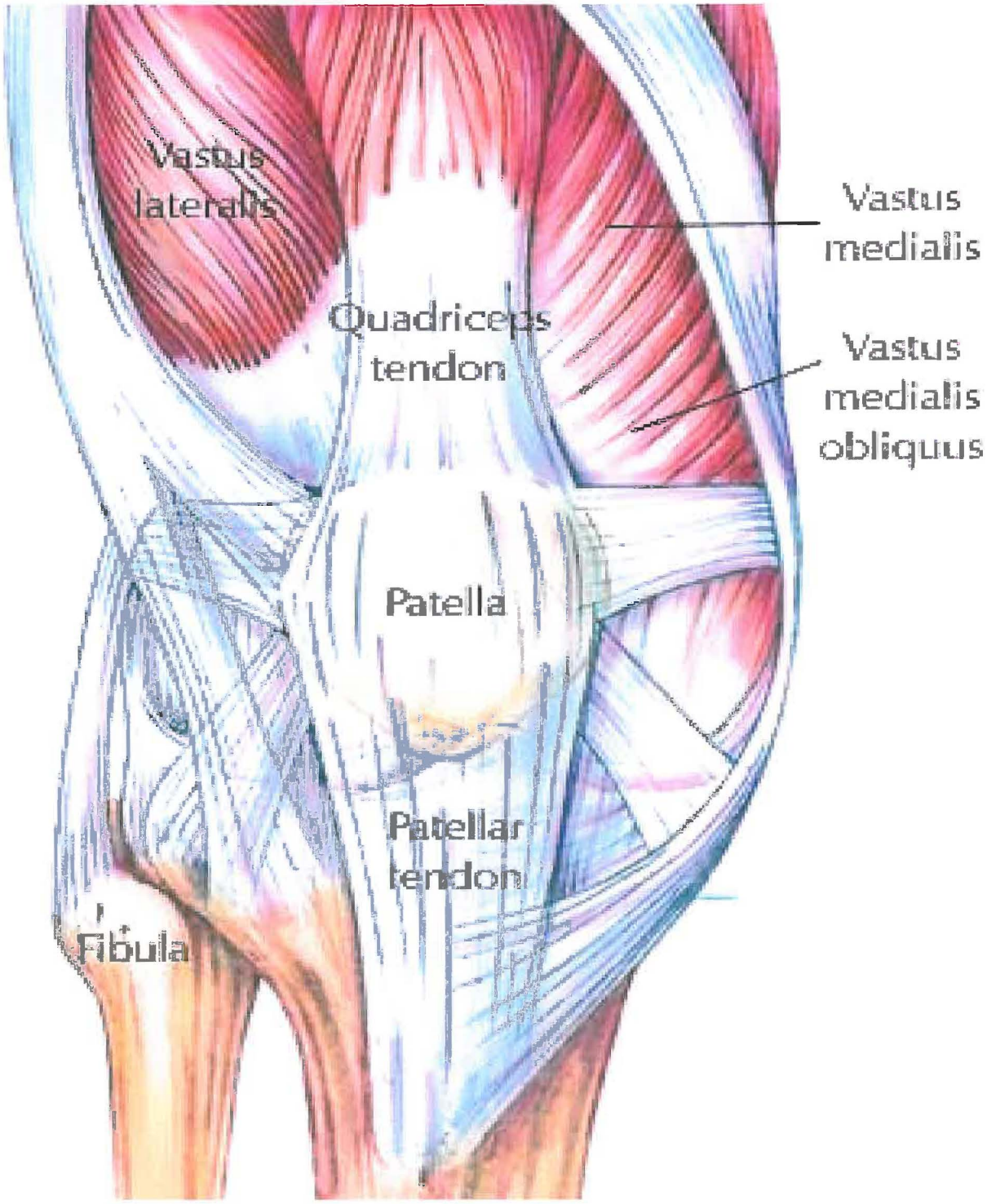
PIP: proximal interphalangeal.

PIR: post-isometric relaxation.

sin: sinister; left.

4. General Part.

4.1 The Knee; Anatomy and Biomechanics.



Picture 1: The Knee.

Introduction.

From a mechanical point of view, the knee is a compromise which sets out to reconcile two mutually exclusive requirements;

1 - To have great stability in complete extension, when the knee is subjected to severe mechanical stress resulting from the weight of the body and the length of the levers with the knee as fulcrum,

2 - To have great mobility in flexion, which is essential for most activities of locomotion.

To better understand the mechanics of the knee, let's visualize it as a dynamic equilibrium; windsurfing provides a close analogy, with its three components of equilibrium:

1 - The sea, supporting the windsurfing board → articular surfaces;

2 - The wind pushing at the sail provides movement → muscles;

3 - The surfer, guiding the board by his constant reactions to the sea and the wind → ligaments.

As such, the movements of the knee are determined by mutual and balanced interactions between these three factors - articular surfaces, muscles and ligaments - and are an example of a trilateral dynamic equilibrium.

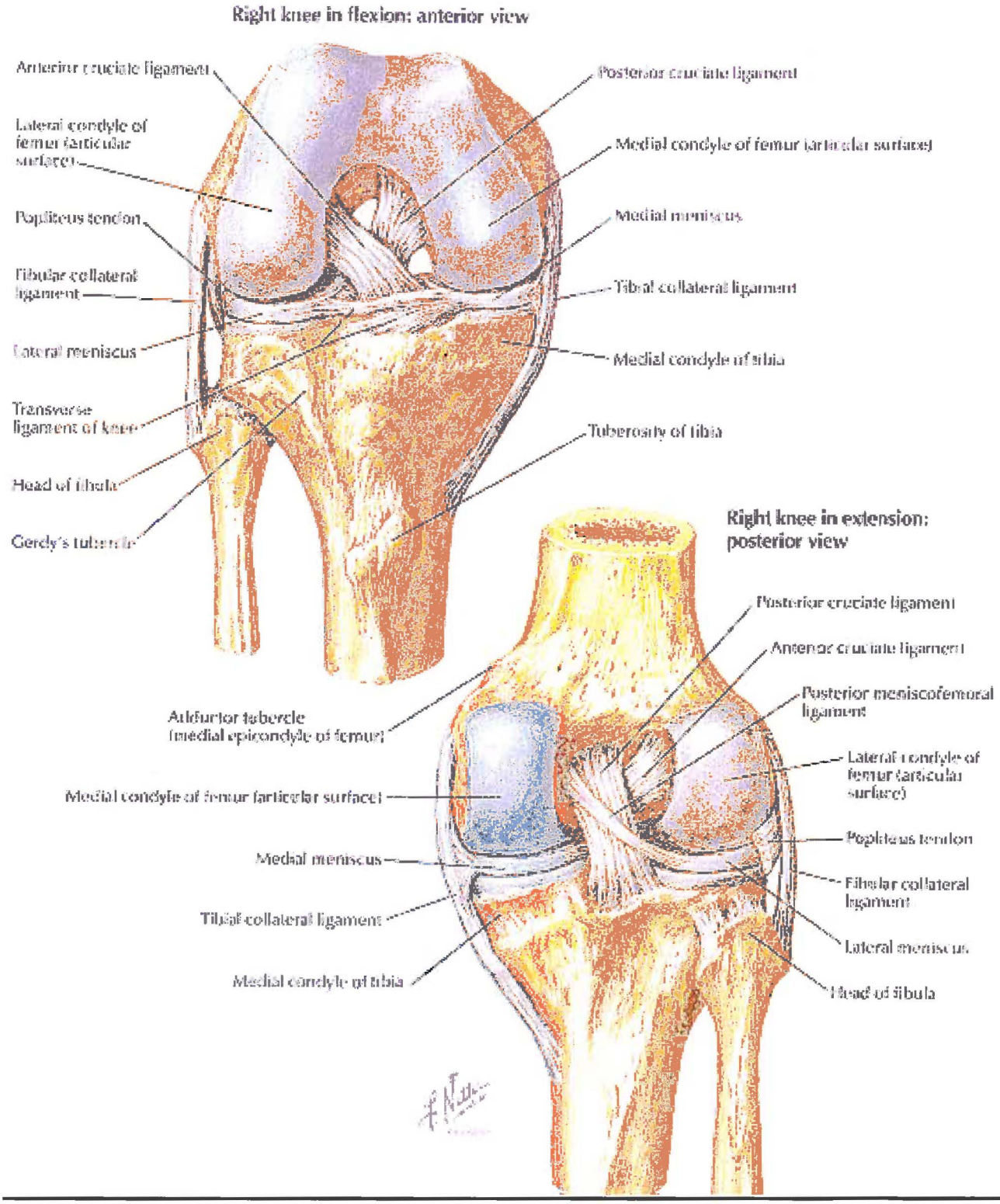
Let's have a more thorough look at the anatomy and biomechanics of the knee joint (7):

The Capsule.

The inner lining of the fibrous capsule is covered by synovium, which produces synovial fluid, which is an important constituent of a synovial joint. Not only does it act as a lubricant and shock-absorber, it also acts as a conduit for nutrients, and may have hormonal and messenger functions. Embedded within the fluid are also nociceptors, which are "protected" by the fluid. Normally the amount of synovial fluid is very small, amounting to only a few cm. However, the movements of flexion and extension ensure that the articulating surfaces are constantly bathed by fresh fluid, ensuring proper nutrition of cartilage and lubrication of the articular surfaces.

The capsule does not enclose the cruciate ligaments within, but it does envelop the proximal origin of the two gastrocnemial heads and the tendon of the popliteus muscle. At the anterosuperior attachment on femur, it folds on itself to form the suprapatellar bursa (4, 7).

The Ligaments.



Picture 2: The Ligaments of the Knee.

Four main ligaments are present to prevent excessive movements; the medial collateral, the lateral collateral, the posterior cruciate and the anterior cruciate.

The medial collateral ligament is located at the medial aspect of the knee joint, and extends from the medial femoral epicondyle to the tibia. This ligament prevents excessive lateral displacement of the tibia on the femur.

The lateral collateral ligament is located at the lateral aspect of the knee. It extends from the lateral femoral epicondyle to the head of the fibula. It prevents excessive medial displacement of the tibia on femur.

The anterior cruciate ligament extends from the anteromedial aspect of the tibial plateau to the medial part of the lateral femoral condyle. It's job is to prevent excessive anterior movement of tibia on femur.

The posterior cruciate ligament extends from the lateral aspect of the medial femoral condyle to the posterolateral tibial plateau. It resists forces wanting to push the tibia posteriorly relative to femur.

There's also three other ligaments at the knee; the patellar and the oblique and arcuate popliteal ligaments.

The patellar ligament is a continuation of the quadriceps tendon, that envelops the patella and than proceeds as the patellar ligament to attach to the tibial tuberosity. This mechanical chain will be addressed further when discussing the quadriceps.

The oblique popliteal ligament is attached superiorly to the upper margin of the intercondylar fossa, and below to the posterior margin of the head of the tibia.

The arcuate popliteal ligament is a broad fibrous band attached above to the lateral condyle of the femur and passing inferomedially, blending with the posterior part of the capsule (5, 7, 12, 14).

The Menisci.

The menisci are the shock-absorbers of the knee - wedged horizontally between the femur and the tibia. They fill in the incongruence between the rounded ends of the femur bone and the flattened ends of the tibia bone upon which the femur sits. The two menisci differ in shape and mobility.

The lateral meniscus is more O-shaped and quite highly mobile, able to slide forwards and backwards with knee movement. The popliteus tendon passes along one edge, which breaks the attachment to the capsule of the joint, and this adds to the mobility.

The medial meniscus is larger and more C-shaped, and tightly bound to the capsular structures and to the medial collateral ligament along the outer rim. It moves very little with the movement of the knee. It is this inflexibility which leads to the medial meniscus being torn more frequently than the lateral meniscus. The lateral one can move and absorb impact, while the medial one simply rips (5, 7, 12, 14).

The Muscles.

The **quadriceps femoris** is the extensor of the knee. It is a powerful muscle, three times stronger than all the knee flexors together, and it has to be, as it singled-handedly prevent us from falling down from an erect position, as long as the knee is in a position of flexion. When we are in a position of 0° knee E or more, the quadriceps does not have to be active for us to maintain that position. The patella's main function is to increase the effectivity of the quadriceps, as it shifts the fulcrum of pull more anteriorly.

The quadriceps femoris, as its name implies, comprise four separate muscle bellies; the rectus femoris, the vastus medialis, the vastus intermedius and the vastus lateralis.

The three vastii are all acting over only one joint, and cause only extension. However, the vastus medialis is more active on an externally rotated limb, or if performing external rotation and knee extension simultaneously, while the vastus lateralis is more active on an internally rotated limb or if knee extension is accompanied by internal rotation.

The vastus medialis should be more powerful than the vastus lateralis to prevent the patella from dislocating laterally.

The rectus femoris acts over both the hip, where it does flexion, and over the knee where it does extension. However, it provides only one fifth of the total power of knee extension. Its efficiency as a knee extensor depends on the amount of hip F; the less hip F, the more efficient it is at extending the knee. Conversely, the more knee F, the more efficient it is at producing flexion at the hip.

The flexors of the knee are primarily the hamstrings - semitendinosus, semimembranosus and the short and long head of biceps femoris - and secondarily the gracilis, sartorius and popliteus, and thirdly the two heads of gastrocnemius.

The **hamstrings** all provide both extension of the hip and flexion of the knee, and their efficiency as knee flexors increase as the hip is flexed.

The **sartorius** is primarily a flexor, abductor and lateral rotator of the hip, but it also function as

a flexor of the knee, which is why it is often short in patients after knee surgery.

The **gracilis** produce adduction and flexion at the hip, and flexion and medial rotation of the knee.

The **gastrocnemius** is practically a useless flexor of the knee, but it is nevertheless a powerful stabilizer of the knee. As it contracts in the early phases of walking, when the knee extends and the ankle plantarflexes, it forces the femoral condyles anteriorly on the tibia, acting as an antagonist-synergist to the quadriceps femoris.

The flexors are at the same time rotators of the knee. Those attached lateral to the vertical axis of rotation are lateral rotators, while those attached to the vertical axis of rotation are medial rotators.

The medial rotators comprise the sartorius, semitendinosus, semimembranosus, gracilis and popliteus. The act as a brake on lateral rotation on a flexed knee, and thus protect the capsule and ligaments when the knee is violently subjected to lateral rotation.

The lateral rotators comprise the biceps femoris and tensor fasciae latae.

The tensor fasciae latae acts as a lateral rotator and flexor on an already flexed knee. As soon as the knee reaches the position of reference, it looses its ability to rotate and flex, and keeps the knee in extension.

Together, medial rotation and extension of the knee tightens all ligaments of the knee, thus enabling the knee joint to maintaining erect posture all by itself, without the aid of muscles. This is in other words, the least energy expending posture (5, 7, 12, 14).

4.2 Movements of the Knee Joint.

Flexion and extension are the primary movements of the knee joint and their range of motion is measured from a position of reference, which it is in when tibia and femur share the same longitudinal axis, when seen from a lateral view.

An **extension** movement occur as the distance between the distal tibia and the proximal femur increases. From maximal flexion to the position of reference, this extension movement is termed relative extension, as the foot is still in flexion. However, there should not be any absolute extension, that is, active movement possible into extension from the position of reference. Passive absolute extension should range from 5°-10°.

Flexion is the opposite movement to extension and the range of flexion depends on the position of the hip and whether it is passive or active. Active knee flexion may reach 140° if the hip is flexed

and 120° if the hip is extended. This is due to the hamstrings loosing its efficiency as the hip moves into extension. The range of passive knee flexion depends upon the amount of muscle mass between the approaching bones, but may reach 160°.

Rotation may only occur on a flexed knee. If measured on a subject sitting on a bench with his lower legs hanging off the table, active medial rotation may reach 30° and active lateral rotation may reach 40°, but this depends on the degree of flexion in the knee. Lateral and medial rotation of the knee is important contributors to adduction and abduction of the ankle (5, 7, 8, 12).

4.3 Osteoarthritis.

Osteoarthritis (OA) is the most common disorder of joints, as it will affect about 10-25 % of any given population above the age of 65. It is a bit difficult to assess the prevalence of OA, as one might define OA from radiological findings or from clinical signs and symptoms.

The knee is the most common joint affected, with the hip joint the second most affected. Below the age of 50, it is more common in men, but it becomes more and more common in women as age increases. It has been suggested that this increase in prevalence among women may be associated with post-menopausal estrogen deficiency. It is also much less common in Black and Asian populations, than in Caucasian, although it is more common in Black women than in Caucasian women.

OA tends to affect certain joints and to spare others. Joints commonly affected are knee, hip, hand (in particular the DIP and PIP of the fingers and the CMC joint of the thumb), cervical spine, lumbosacral spine and the 1st MTP joint of the foot. Ankle, wrist, elbow and shoulder are almost never affected.

As research into OA advances, it is becoming clear that there is no single etiology. Genetics certainly contributes, as it has been found that siblings of patients undergoing arthroplasty due to OA, themselves have an elevated risk of developing OA. Triggering factors of developing OA is trauma, metabolic dysfunction, nutritional deficits, mechanical factors, et c..

Mechanical factors may include congenital defects such as Legg-Perthe's disease, slipped femoral epiphysis and congenital dislocation of the hip, occupational hazards involving a lot of knee bending or resting on the knee for long periods of time, or sports such as football or other elite athletes. There is no evidence so far that leisure jogging or running predispose to OA.

It is thought that OA is the result of the body trying to repair itself after these triggering factors, and as the triggering factors are still ongoing, a battle between anabolic and catabolic processes begin,

which the body lose, and the resultant is degenerative changes of the joint.

The initial catabolic process is a breakdown of the articular cartilage in a small localized area. This leads to changes in the proteoglycan matrix, with increased activity of the chondrocytes and an increased water content. These changes reduce the impact-absorbing properties in the area, leading to thinning and subsequent breakdown of the cartilage.

At this stage, the repair process comes into place, ant attempts are made to increase vascularity and remodel the surface. Chondrocytes and osteophytes develop at the fibrocartilaginous edges of the joint areas, which has the potential to increase the joint area, to possibly increase joint stability and area available for articulation.

At the same time, changes occur in the surrounding bone. Sclerosis appears as new bone develops to strengthen the existing trabecular structure. Due to some area missing articular cartilage, intra-articular pressure develops, and the pressure forces its way into the bone marrow, where it causes bone cysts to form, which may increase in size until the pressure is equalized.

At the same time, metabolites from catabolic reactions are deposited inside the joint, and may cause an inflammatory type of reaction, which may lead to inflammation of the synovial membrane, synovitis, and eventually to effusion within the joint, which, in the long term, cause a stretching of the joint capsule and a resultant thickening as a response to the stretching.

Pain, stiffness and functional impairment are the main symptoms of OA. Pain related to use or immediately after use. Pain varies from between individuals and from day to day, and may range from dull to sharp and sudden. Pain becomes more persistent and more severe with time. The joints affected tend to look enlarged compared to the contralateral unaffected joint, and this is due to the bony changes of osteophyte growth at the joint margins (4, 13, 6, 15, 16).

4.3.1 Osteoarthritis Treatment.

There are many types of accepted treatment for osteoarthritis. These therapies can be divided into two major groups: non-surgical and surgical.

Non-surgical.

Medications: The most common types of medications used to reduce pain in osteoarthritis include acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs) and analgesics.

- Acetaminophen has been shown to be as effective as non-steroidal medication in treating the pain of knee osteoarthritis. Individuals should keep their dose of acetaminophen to under 2000 mg a day as higher doses could cause kidney disease.
- NSAIDs are very effective in treating the pain of osteoarthritis. However, their use is somewhat limited as they have many side effects including ulcer formation, heartburn, confusion, kidney and liver problems. Moreover, they can interfere with anti-clotting medications and some medications used to treat high blood pressure.
- Analgesics: Other pain medications, non-narcotic and narcotic, can be used for pain control. Narcotic medications can be addicting over time.

Nutritional supplements: There has been much interest in the field of nutritional supplements that are the building blocks of cartilage. These products such as glucosamine and hyaluronic acid, are non-prescriptive, and have been shown in a limited number of studies to possibly slow the progression of osteoarthritis.

Physical therapy: Physical therapy is aimed at restoring muscle strength, protecting the joint and maximizing the amount of function that a joint has. Physical therapy can be especially beneficial to the patient who wants to delay surgical intervention.

Occupational therapy: Occupational therapy is aimed at providing direction in performing the activities of daily living and recommending appropriate devices such as canes and bathroom equipment to maintain independence.

Exercise: Some studies have shown that generalized conditioning and aerobic exercise can decrease pain and increase function in patients with osteoarthritis.

Self-management: Small groups, patient education, and contact with a provider are all beneficial in dealing with osteoarthritis.

Weight loss: Although weight loss can not reverse the damage that has been done to a joint, it can decrease pain, enhance rehabilitation and improve surgical outcome.

Surgical Intervention: There are several different types of surgical interventions.

- **Arthroscopy**: The surgeon makes a small incision in the skin and places a small tube through which he can examine the joint and perform procedures such as scraping cartilage or bone and repairing ligaments.
- **Osteotomy**: In an osteotomy the surgeon will remove part of the bone in a joint to realign the joint as a temporary treatment for osteoarthritis.
- **Arthroplasty/Joint Replacement**: In arthroplasty, the surgeon removes part of the bone and replaces the joint with a man-made joint. These man-made joints are ever improving and can last many years (1, 2, 4, 11, 13, 6, 15, 16).

4.4 Total Knee Replacement.

4.4.1 Surgery.

As this is a thesis from a physiotherapy student and not a medical student, the description of the surgical procedure will include just a general overview. Pictures are included in Supplements.

Preparation.

The patient is first taken into the operating room and given anaesthesia. After the anaesthesia has taken effect, the skin around the knee is thoroughly scrubbed with an antiseptic liquid. The knee is flexed about 90 degrees and the lower portion of the leg, including the foot, is placed in a special device to securely hold it in place during the surgery. Usually a tourniquet is then applied to the upper portion of the leg to help slow the flow of blood during the surgery. An incision of appropriate size is then made.

Removing the damaged bone surfaces.

The damaged bone surfaces and cartilage are then removed by the surgeon. Precision instruments and guides are used to help make sure the cuts are made at the correct angles so the bones will align properly after the new surfaces (implants) are attached.

Small amounts of the bone surface are removed from the front, end, and back of the femur. This shapes the bone so the implants will fit properly. The amount of bone that is removed depends on the amount of bone that has been damaged by the arthritis.

A small portion of the top surface of the tibia is also removed, making the end of the bone flat.

The back surface of the patella is also removed.

The anterior cruciate ligament is never spared, but the posterior cruciate ligament may or may not be spared, depending on the surgeon. The medial and lateral collateral ligaments and all other structures are always spared.

Attaching the implants.

An implant is attached to each of the three bones. These implants are designed so that the knee joint will move in a way that is very similar to the way the joint moved when it was healthy. The implants are attached either using a cemented procedure, or a non-cemented procedure. See below for details.

The implant that fits over the end of the femur is made of metal. Its surface is rounded and very smooth, covering the front and back of the bone as well as the end.

The implant that fits over the top of the tibia usually consists of two parts. A metal base plate fits over the part of the bone that was cut flat. A durable plastic articular surface is then attached to the base plate to serve as a spacer between the base plate and the metal implant that covers the end of the femur.

The implant that covers the back of the patella is also made of a durable plastic.

Artificial knee implants come in many designs. Some designs may have pegs, requiring small holes to be drilled into the bone after the damaged surfaces have been removed. Others may have central stems. In addition, some designs may allow screws to be used on the lower implant to provide added attachment security. The surgeon will choose the implant design that best meets the patient's needs.

Closing the wound.

If necessary, the surgeon may adjust the ligaments that surround the knee to achieve the best possible knee function.

When all of the implants are in place and the ligaments are properly adjusted, the surgeon sews the layers of tissue back into their proper position. A plastic tube may be inserted into the wound to allow liquids to drain from the site during the first few hours after surgery. The edges of the skin are then sewn together, and the knee is wrapped in a sterile bandage. The patient is then taken to the recovery room.

4.4.2 Different techniques of attaching the implants.

Cemented procedure.

With a cemented procedure the components of the implant are fixed to the bone with a grout-like cement known as polymethyl-methacrylate. This cement allows the implants to perfectly fit to the irregularities of the bone.

A cemented knee is a very reliable procedure with approximately 90 to 95 % expected to enjoy pain-free activities for at least ten years beyond surgery. The advantage is that this type of knee replacement is immediately stable and one can walk fully bearing weight immediately following surgery. The disadvantages are that if it should become loose, some bone may be ground away by the loosened cement potentially making revision more difficult.

Non-cemented procedure.

In a non-cemented procedure, components of the implant have a roughened porous surface designed to allow bone to grow into it, eliminating the need for cement.

The implants are "press fit" against the bony surfaces that are precisely cut through the use of multiple cutting jigs. Faultless positioning is necessary for bony attachment to occur with initial fixation by metal pegs and screws of the implant to bone. Since this implant relies on the bone to hold it in place, this procedure requires good bone to be successful

Since the non-cemented procedure is relatively new, years of experience and studies are not available regarding this type of implant as compared to the cemented implant. Therefore, at this time it is not yet known if a non-cemented implant will be as successful or will last as long as the cemented type.

One potentially positive aspect is that if this implant should become loose, less bone loss may occur due to the lack of the irritant cement. After surgery the individual with this type of implant is usually instructed to be toe-touch only until a follow-up x-ray usually done by the fifth or sixth week after surgery. The weight-bearing status following non-cemented knee replacement will be determined by the surgeon.

Hybrid fixation procedure.

Occasionally a hybrid fixation is used which consists of a combination of the cemented and non-cemented techniques. In this method the femoral component is not cemented and the tibia component is cemented.

At present, cemented knee replacements are most commonly used, representing 90 % of knee replacement surgery. Non-cemented replacements are much less common, as are hybrid replacements.

4.4.3 Categories of knee replacement.

Broadly speaking, there are four basic categories of knee replacements depending on the degree of mechanical stability provided by the design of the artificial knee.

Non-constrained.

The highly successful non-constrained implant is the most common type of knee arthroplasty. It is termed non-constrained because the artificial components inserted into the knee are not linked to each other and have no stability built into the system. It relies on the person's own ligaments and muscles for stability. This is the key feature of this group of artificial implants helping to maintain the stability of the knee.

Semi-constrained.

The semi-constrained implant is a device that provides increasing stability for the knee. This type of artificial knee has some stability built into it. It is used if the surgeon needs to remove all of the inner knee ligaments (some surgeons prefer to do this), or if the surgeon feels the new knee will be more stable with this type of implant.

Constrained.

Constraint or hinged implants are rarely used as a first choice of surgical options. In this case, the two components of the knee joint are linked together with a hinged mechanism. This type of knee replacement is used when the knee is highly unstable and the person's ligaments will not be able to support the other type of knee replacements. It is useful in the treatment of severely damaged knees particularly in very elderly people undergoing a revision replacement procedure. The disadvantage of this type of knee joint is that it is not expected to last as long as the other types.

Unicondylar.

A unicondylar knee replacement replaces only half of the knee joint. It is performed if the damage is limited to one side of the joint only with the remaining part of the knee joint being relatively spared. It is now possible for the surgeon to replace only that area of the knee joint which is severely damaged. However, even with only half of the joint destroyed, many surgeons prefer doing a total knee replacement believing this is a better procedure than the half-knee (unicondylar) replacement, but equally, there are surgeons who believe it is more appropriate to perform a unicondylar knee in the right circumstance.

4.4.4 Possible Risks and Complications.

As with all major surgical procedures, complications can occur. Some of the most common complications following knee replacement are Deep Venous Thrombosis (DVT), Infection, Stiffness, Loosening and Osteolysis.

Deep Venous Thrombosis.

This term refers to the formation of blood clots (called thrombus) in the large veins, usually of the legs or pelvis. It can occur after any operation, but is more likely to occur following surgery on the hip, pelvis, or knee. It results from the slowing of the blood flow in the leg during and after surgery. A DVT may cause the leg to swell, become warm to the touch or become painful.

Infection.

The chance of getting an infection following artificial knee replacement is less than 1 %. Some infections may show up very early, even before discharge from the hospital. Others may not become

apparent for months, or even years, after the operation. All patients receive antibiotics for at least 24 hours after surgery to minimize the risk of infection. Infection can also spread into the artificial joint from other infected areas of the body.

Therefore, the surgeon may want to make sure that the patient take antibiotics whenever going to the dentist, or undergoes a surgical procedure on his bladder and colon to reduce the risk of spreading germs to the replaced knee, and to minimize the risk of infection, most surgeons will defer doing total knee replacement if there is an open wound anywhere on the body.

Stiffness.

This is discussed thoroughly under section 4.3.2 Biomechanics of a replaced knee.

Loosening.

The major reason artificial joints may eventually fail, is because of loosening where the metal or cement meets the bone. There have been great advances in extending how long an artificial joint will last, but loosening is a possibility that may require a revision.

Today one can expect 12-15 years or more of service from an artificial knee. However, in some cases the knee will loosen earlier. A loose artificial implant becomes a problem because of pain and wearing away of the bone. If loosening occurs, another knee replacement may need to be done (this is called a revision total knee replacement). Therefore it is sensible for the individual to have yearly follow up visits with their surgeon that will include an x-ray evaluation of the operated knee.

Osteolysis.

A complication that can cause the artificial components to loosen or damage the bone is called osteolysis meaning "breakdown of bone". This may result over the years from tiny particles of worn-out plastic or cement that may potentially migrate into the bone and cause localized damage to the bone. This condition may also result in the need for a total knee revision. That is another reason to have a yearly x-ray evaluation (1, 2, 10, 14).

4.4.5 Biomechanics of a replaced knee.

The procedure has been proven to help individuals return back to moderately challenging activities such as golf, bicycling, and swimming. Total knee replacements are not designed for jogging, or sports like tennis and skiing (although there certainly are people with total knee replacements that participate in such sports).

The general goal of total knee replacement is designed to provide painless and unlimited standing, sitting, walking, and other normal activities of daily living.

To be able to use the knee effectively to rise from a chair, the replaced joint must bend at least to 90 degrees. Most surgeons desire range of motion greater than 110 degrees. In some cases, the ability to bend the knee does not return to normal after an artificial knee replacement. Because of this many surgeons utilize physical therapy beginning immediately after the surgery to help regain range of motion, including continuous passive motion (CPM): This involves the use of a specialized machine immediately after surgery to increase the range of motion of the operated knee following artificial knee replacement.

Occasionally, excessive scarring after surgery can lead to an increasingly stiff knee. If this occurs, the surgeon may recommend taking the individual back to the operating room after the surgery and simply manipulate (i.e. bend) the knee under anaesthesia to regain motion. This allows the surgeon to break up and stretch the scar tissue to increase the motion in the knee without injuring the joint.

The most important factor in preventing stiffness is keeping the knee moving in the days and weeks following surgery and active participation in a physical therapy program (1, 2, 10, 17).

4.5 Rehabilitation.

4.5.1 The General Objectives of Knee Rehabilitation.

protecting the joint in the early stages from further mechanical injury via the appropriate use of braces, crutches or sticks,

reducing internal swelling as soon as possible to allow full mobilisation,

reducing inflammation, so that adhesions are not formed and that secondary destruction is not initiated by enzyme release from inflamed tissues,

identifying infection early before it has a chance to spread,

restoring range of motion (ROM) to prevent later permanent limitation of flexion or extension,

maintaining muscle responsiveness and limiting inhibition in the early phases and actual wasting in the later stages,

freeing adhesions so that they do not organise into thicker scar tissue, which might restrict joint mobility,

rebuilding muscle strength to restore function and also to stabilise the joint and protect it from further injury,

restoring gait patterns to prevent strain in the back, the hip or the other leg,

restoring proprioception or internal spatial awareness in the knee, to prevent damaging it again,

building endurance to strengthen bones and the cardiovascular system (heart and lungs),

building nutritional awareness to optimise weight and correct dietary imbalances.

4.5.2 The Phases of Rehabilitation.

Short term RHB:

Short term rehabilitation can be divided into different phases, and the main focus is rebuilding quadriceps and hamstring strength and regaining good range of motion, as well as teaching crutch walking, as the patient will be on crutches for at least three months, according to the surgeon.

Immediate phase:

Immediately after surgery, care focuses on pain relief, protecting the knee and maintaining its vital functions, such as blood flow and nerve supply.

One exercise that can be done at this stage to prevent inhibition of the quadriceps muscle, is **the Static Quad exercise**. While lying supine in bed, contract the quadriceps muscle and hold for 5 counts. Do a total of 5 contractions every hour or so.

One exercise to prevent deep vein thrombosis is **the Foot Pump exercise**. While lying supine in bed, dorsiflex the ankle and hold for 5 counts. Plantarflex the ankle and hold for 5 counts. This is one repetition. Do a total of 5 repetitions every 30 minutes.

Early phase - in bed:

In the early phase after injury or surgery, when the knee is painful and tense with internal bleeding or fluid, and the patient is in bed, it is very tempting for the patient to just keep it still and avoid hurting it further, but it is very important to keep the knee moving unless there is a complication. This is to:

- Prevent DVT - via CPM and foot pumps,
- maintain flexion to keep the knee mobile to prevent adhesions forming - via CPM, heel slides and facilitated heel slides,
- maintain extension - via static quads, passive extension and short arc extensions,
- limit swelling and inflammation - via icing and anti-inflammatories,
- prevent quadriceps muscle inhibition - via static quads.

When the joint is operated upon, there is usually an excess of joint fluid in the joint space. There may also be blood in the joint. At first this fluid is quite liquid and can easily be aspirated with a needle and syringe. Later, however, the bulk of the liquid is reabsorbed and the remaining fluid becomes sticky and forms strands (adhesions) stretching across the joint cavity. These may form in the

pouch above the kneecap (suprapatellar pouch) or in the space below the kneecap (the anterior interval) or in the gutters at either side of the joint space.

A CPM (continuous passive motion) machine is an apparatus which is attached to the leg, and which takes the leg passively through the range of motion set by a physiotherapist, nurse or physician. This has the effect of minimising stiffness from internal swelling. It is of particular value after knee replacement, cruciate ligament surgery and microfracture, but may be applied routinely post knee surgery, generally only for one or two sessions a day. The machines are generally set to allow a limited range of motion, so as to not place the swollen knee under undue stress. The speed is also variable.

The Heel Slide is a simple early exercise to maintain some range of movement. They can be done in bed even while the knee is still painful, as long as the surgeon allows it and the knee is not in an immobiliser. While lying supine, pull the heel towards the buttocks as far as it will go until pain is felt, then slowly push it down again into the resting position. Repeat 4-9 times, several times pr day.

If the hamstrings are too weak to do a heel slide unassisted, the normal leg can facilitate the exercise by helping pull the operated leg. This is **the Facilitated Heel Slide exercise.**

Passive extension ensures that the knee retains full extension (straightening). While lying supine in bed, put a rolled-up towel or a pillow under the ankles. The weight of the leg will force the knee straighter into extension. This will help prevent a flexion deformity to develop.

The Short Arc Extension exercise: While lying supine, place a pillow under the knee or the distal thigh, and actively extend the knee. Do it 10 times.

Early phase - mobile:

- Maintain comfort,
- maintain passive range of motion to prevent internal adhesions and stiffness,
- prevent quadriceps atrophy,
- solve complications early.

When the patient starts to walk after a period in bed there are new things to focus on. The muscles are likely to be weaker than normal, and the inflammatory process will be inclined to produce adhesions. Rehabilitation needs to focus on flexibility, strength and proprioception, and crutch walking should be taught.

Intermediate phase:

- Start active mobilisation, but avoid reflex quadriceps inhibition,
- actively increase range of motion and strength,
- restore proprioception.

Hamstrings stretches are really important to allow the knee muscles to balance properly, and thus prevent further injury. The hamstrings tend to weaken and contract, especially after some time on crutches. Initially this is reversible, but later on the shortening can become permanent, with loss of range of motion. A simple stretch is to sit and bend forward, reaching the toes with your fingers, or lying on your back with non-operated leg flexed at the hip and knee with sole of the foot on the ground, while holding a towel or belt in the hands, putting the operated foot in the loop, straightening the operated leg, and pull it towards your trunk while maintaining the straight leg.

Piriformis and iliotibial band also may need stretching at this point.

The Full Arch Extension exercise can be used both to increase quadriceps strength and proprioception. While sitting on the or on a chair, keeping non-operated foot on the ground, slowly extend and flex the knee repeatedly. Do 3-5 sets and 6-12 repetitions. When able to do 5 sets of 12 reps, attach a TheraBand or a weight to both legs, and flex one knee while the other extends. Increase resistance as strength improves.

The Straight Leg exercise will help improve proprioception, hip and knee flexor strength and balance between agonist, synergist and antagonist. While lying supine or supported on your elbow behind you, with non-operated leg flexed at hip and knee with sole firmly on the ground, the other leg on the ground fully extended, flex the operated foot at the hip, while maintaining knee extension. Perform movements slowly up and down. As strength increases, add resistance in forms of weight collars or TheraBand.

The Bridge exercise is a good exercise for both stretching hip flexors and increasing hip extensor strength. While lying supine, with both feet flexed at the hip and knee and soles of feet firmly on the ground, thrust the pelvis slowly up towards the roof, hold for 5 counts, and slowly lower to the ground again. Repeat for maximally 12 repetitions and 5 sets. Concentrate on performing movement slowly. To also include hip adductors, place a ball or pillow between the knees while doing the exercise.

Hip Abductor exercises. Hip abductors also need strengthening. While lying supine in bed with legs straight, start by abducting both legs simultaneously. This will prevent activation of quadratus

lumborum. When this is easily done for ten repetitions, add a TheraBand and increase as strength improves, or move to a sidelying position, balancing yourself with one arm under the head and the other in front of you. Then do hip abduction. TheraBands can be used in this exercise as well, to increase resistance.

Long term RHB:

The key principles are to:

- Build strength & endurance,
- balance the main muscle groups,
- maintain range of motion,
- prevent further damage by optimising your weight and regaining full position sense in the knee (1, 2, 17).

5. Special part.

5.0 Methods.

The clinical practice on which this special part of the thesis is based, was held during a two-week period from Monday the 4th of February 2008 to Friday the 15th of February 2008, at Revmatologicky Ùstav at Albertov, Prague, Czech Republic.

The patient stayed at the hospital for a total of three weeks after her operation, and the author of this thesis was the responsible physiotherapist for the last two weeks, and physiotherapy was given as is indicated in the following special part.

Revmatologicky Ùstav is an in-patient and out-patient rehabilitation clinic, offering treatment for patients who suffer from rheumatologic and connective tissue disorders. They have a fully equipped hydrotherapy and electrotherapy department.

Tools and equipment used during the two weeks was goniometer, yellow, red and green TheraBands and the CPM.

5.1 Anamnesis.

5.1.1 Patient.

-MS, female born 1931, 77 years old.

5.1.2 Diagnosis.

-Total knee replacement l. dx., due to osteoarthrosis. Surgery performed at Motol 22.01.08.

5.1.3 Family anamnesis.

-1 daughter; healthy.

-Mother; died of breast cancer when she was 82 years old.

-Father; died of lung cancer when he was 69 years old.

-Brother; died of lung cancer when he was 54 years old.

5.1.4 Personal anamnesis.

Injuries & Surgeries.

-Fracture of left antebrachium after falling on the ice in 1959.

-Fracture of right antebrachium after falling on the ice in 1961.

-Replacement of PIP joint of 4th finger left hand due to osteoarthritis.

-Compression fracture of Th_{11} due to osteoarthritis.

-Total hip replacement l. sin. 09.01.2000, after falling on her hip, fracturing femoral head and undergoing necrosis.

-Surgery of retinopathy on both eyes in 2006.

Other Pathology.

-Hypertension; decreased by medicine.

-Hypercholesterolemia; receives statimen therapy.

-Ischemic disease of the heart.

-Possible hyperparathyreosis, but needs further testing to determine diagnosis.

Gynaecological anamnesis.

-1st menstruation at the age of 13.

-Regular menstruation.

-Mammography has revealed no tumour.

-36 years of age: Myoma is discovered. Hysterectomy and adnexotomy is performed to remove the myoma. This terminates menses.

-Pregnant twice; two premature births, one survived (daughter).

Allergies.

-At some time, she was taking Vitacalcin, but she got a red rash in her face, and they decided she was allergic.

Present medication.

-1-0-0 means 1 tablet in the morning, none for lunch, none for evening.

-If dosage is not specified at all, there was not given any information of dosage.

1-Clexane 0,4 ml.

2-Sorbimon 20 mg; 1-0-0.

3-Tenolog 200; 1/2-0-0.

4-Simvacard 20; 0-0-1.

5-Cardiolipin 5; 1-0-0.

6-Agapurin.

7-Anopyrin 500 mg.

8-Vigantol; 2 tablets pr day.

9-Calcichew D3; 1-0-0.

10-Fosamax 70; one a week.

Stimulants.

-Drinks wine on occasion.

-Drinks 2 cups of coffee daily.

-She doesn't smoke at the present, but used to smoke up to 20 cigarettes per day from the age of 25-69.

5.1.5 Social anamnesis.

-Retired. Used to work at a factory as a storage manager. No heavy lifting, mostly sitting.

-She lives alone in a block with elevator.

5.1.6 Extract from Medical Documentation.

-X-ray photos of right and left knees, right and left feet, right and left forearms and right hand.

-Copies of X-ray photos of knees are included in the thesis.

5.1.7 Indication of Rehabilitation by Surgeon.

-Increase length of shortened muscles; CPM for 30 minutes daily to increase length of knee extensors.

-Increase muscle strength of hip and knee muscles.

5.1.8 Previous Rehabilitation.

Since hospitalization at Revmatologicky Ustav 30.01.08:

-A complete medical examination by admitting medical doctor, including more or less everything one might think of, excluding orthopaedical examination, for some reason. No pathological conditions was found, except what is enclosed in the anamnesis above.

-30 min daily with electronic stretching device for passive stretching of knee extensors.

-Exercise to increase length of knee extensors. Twice daily.

-Exercises to increase strength of hip and knee musculature. Twice daily.

5.2 Initial kinesiological examination.

5.2.1 Postural Examination.

-Patient has been told by her orthopaedic surgeon not to load her operated foot except touching the ground. This makes postural examination difficult. However, some indications of the patient's posture will be explained. Pictures are enclosed in the Supplements part of the thesis, so the reader can get an indication of the patient's posture.

Posterior view:

-Slight rotation in both subtalar joints, more on the left.

-Right popliteal line indicates internal rotation of the right hip.

-Valgosity of both extremities more marked on the left limb.

-Elevation of right shoulder.

Anterior view:

-Increased lateral rotation of the right foot.

Side view:

-Similar findings from both left and right view.

-She has difficulties standing without supporting herself with her hand on the wall.

-No hallux valgus, neither right nor left.

-Right/Left 2nd toe claw toes.

-Left flat foot and pronation.

-Load mainly on left lower limb.

-Semiflexion in the right knee.

-Trunk is displaced anteriorly and rotated to the right, i. e., trunk and hip F, trunk R.

-Protruding abdomen.

-Hyperlordosis of lumbar spine.

-Decreased kyphosis of lower thoracic spine.

-Increased kyphosis of upper thoracic spine.

-Protraction of both shoulders.

-Decreased cervical lordosis (8, 9).

5.2.2 Gait Examination.

-Patient is walking with axillary crutches, and has been told by her orthopaedic surgeon not to load her operated foot except touching the ground. This makes gait examination difficult.

-Because the patient is walking with crutches, I can not assess synkinetic movements of the arm; the patient can not walk on tip-toes; can not walk on the heels; can not do the short-steps; can not do the walking with increased hip and knee flexion (monkey walking).

-Rhythm: The patient loads the operated foot during walking, so rhythm is good; no antalgic walking visible.

-The patient walks with a stoop; trunk and hip F.

-When ascending stairs, crutches are moved up by elevation of shoulder girdle, not by hip and knee extension.

-Ascending stairs: Non-operated, operated, crutches.

-Descending stairs: Crutches operated, non-operated.

-Level walking: Crutches operated, non-operated.

5.2.3 Breathing Examination.

-Examination performed in supine lying only, as the patient is unable to produce an erect posture.

-Inhalation: Lower abdomen, upper abdomen, anterolaterosuperior widening of the chest. No excessive elevation of shoulder girdle.

-Exhalation: Upper abdomen, deflation and depression of the chest, lower abdomen.

5.2.4 Joint Play Examination.

-Left patella:

-Mobile in both medial and lateral direction, but less so in medial direction.

-A sense of sand or loose particles is felt when performing test.

-Caudal direction is the only test that produces discomfort.

-Right patella:

-Not examined, because stitches are not removed yet, and the knee is still covered in sterile bandages.

-Right/Left tibiofemoral and tibiofibular joints:

-No movement restrictions.

-No excessive movements.

-Left/Right talocrural joints:

-Painful during examination. Test not completed.

-Right Lisfranc and Chopart joints (also include cuboid and navicular bones):

-Mobile in all directions.

-Painful in all directions.

-Left Lisfranc and Chopart joints (also include cuboid and navicular bones):

-Mobile in all directions.

-Not painful in any direction.

-Left/Right metatarsophalangeal and interphalangeal joints:

-Provokes pain.

-No good assessment of joint mobility obtained (9).

5.2.5 Muscle Strength Examination.

Right	Muscle group	Left
4	Hip ABD	4+
5	Hip ADD	5
5	Hip F	5
3+*	Hip E	3+*
**	Hip ER/IR	**
5***	Knee F	5
4	Knee E	4
¤	Ankle PF	¤
¤¤	Ankle DF	¤¤

Table 1: Muscles of the Lower Limb (8).

*against slight pressure only.

**Not tested specifically, but able to move legs through full ROM.

***Through current (restricted) ROM.

¤Not tested, as patient is not allowed to put load on operated leg.

¤¤Not tested.

5.2.6 Muscle Length Examination.

A. Length of Hip Flexors.

-Doing the Kendall "Test for Length of hip flexor muscles", one may assess length of iliopsoas, rectus femoris, tensor fasciae latae and sartorius.

-As the patient lies down, knee extends (left side to a position of 70° flexion, right leg to a position of 60°), the thigh abducts and externally rotates, while the posterior thigh stays on the examination table. Assessment of the previously mentioned muscles are found in table 2. Results are bilaterally equal.

Muscle	Description of Length
Iliopsoas	Not short.
Rectus femoris	Short.
Sartorius	Short.
Tensor Fasciae Latae	Not short.

Table 2: Length of Hip Flexors (8).

B. Length of Hamstrings.

-Kendall utilizes two separate tests to examine hamstring length; "Straight-leg Raising" and "Forward Bending".

-Hamstrings include biceps femoris, semitendinosus and semimembranosus.

-The "Forward Bending" is performed excellently; she is able to touch her toes.

-The "Straight-leg Raising" is also performed adequately; the patient is able to actively flex the right hip to a position of 90° flexion, the left she is able to actively put into a position of 85° flexion. Test is performed with proper fixation according to Kendall.

-The conclusions from the hamstring length assessment: no shortness of hamstrings (Table 3).

Muscle	Description of Length
Forward Bending	Not short.
Straight-Leg Raising	Not short.

Table 3: Length of Hamstrings (8).

C. Length of Ankle Plantarflexors.

-The 1-joint ankle plantarflexors (soleus and popliteus) one may assess by putting the patient's knee in a position close to 90° flexion, and then try to put the ankle into a position of 20° DF. If this is accomplished, the 1-joint plantarflexors are not short.

-As test for testing hamstring length is performed, patient reports pain at the proximal attachment points for gastrocnemius, and thus the 2-joint ankle plantarflexors (gastrocnemius and plantaris) is assessed to be short.

Muscle	Description of Length
1-joint plantarflexors	Not short.
2-joint plantarflexors	Short.

Table 4: Length of Plantarflexors of the Ankle (8).

5.2.7 Range of Motion Examination.

-Because of the patient's total hip replacement l. sin., rotation of hip joint is not tested.

	Range of motion	Range of motion
Motion	**Right side**	**Left side**
Hip F w/knee F	110	90
Hip E	10	10
Hip ABD	45	45
Hip ADD	10	10
Hip ER	45	Not tested.
Hip IR	45	Not tested.
Knee E	-5	0
Knee F	80	135
Ankle DF	20	20
Ankle PF	45	45

Table 5: ROM at some Lower Limb Joints (8).

5.2.8 Conclusion of Initial Kinesiological Examination.

Posture:

-Pronation of both subtalar joints.

-Valgus of both knees.

-Protruding abdomen.

-Anterior displacement of trunk.

-Hyperlordosis of lumbar spine.

-Decreased kyphosis of lower thoracic spine.

-Increased kyphosis of upper thoracic spine.

-Protraction of both shoulders.

-Decreased cervical lordosis.

-She has difficulties standing without supporting herself with her hand on the wall.

Gait.

-Walks with crutches.

-Masters three-point walking, both walking level, up-stairs and down-stairs.

-When moving crutches when walking up-stairs, the crutches are moved by elevation of shoulder girdle only.

Breathing:

-Breathing is faulty;

-Inhalation begins at the lower abdomen, proceeds to the upper abdomen and ends with antero-latero-superior widening of the chest. No excessive elevation of shoulder girdle.

-Exhalation begins with the upper abdomen, proceeds with deflation and depression of the chest and ends with the lower abdomen.

Muscle shortness.

-Bilateral finding of no shortness of 1-joint hip flexors.

-Bilateral finding of no shortness of hip abductors, adductors, extensors, external nor internal rotators.

-Bilateral finding of shortness of rectus femoris, sartorius and gastrocnemius.

-Bilateral finding of weak hip extensors (gluteus maximus and hamstrings).

Other.

-Severely reduced ROM of right knee into flexion.

-Pain at left greater trochanter area during maximal ABD of left hip.

-Painful joint play of both feet.

-Hypertonus of left/right hip adductors.

-Because she has hypertension, even though it is decreased by medication, a therapy proposal should exclude exercises with long periods of isometric muscle contraction.

-Due to the ischemic disease of the patient's heart, long lasting exercise should be avoided.

5.3 Rehabilitation plan.

5.3.1 Short-term.

-Improve ROM of the right knee by Lewit PIR of rectus femoris (9).

-Release tension of left and right hip adductors by Lewit PIR and CPM (9).

-Improve muscle strength of hip extensors and abductors and knee extensors, as well as general conditioning exercises of ankle plantar and dorsiflexors to prevent atrophy (3, 17, 18).

5.3.2 Long-term.

-We want to make the patient able to return to a life of minimal pain and discomfort and maximal independency. This needs rehabilitational work in the following areas:

-Improve patient's posture, especially verticalisation when standing and walking.

-Exercises to improve the pattern of breathing, which is faulty, and may lead to later dysfunction and discomfort.

-Improve joint play of feet.

-Improve activation of small muscles of the feet.

-Start strengthening exercises for ankle plantarflexors.

-Remedial swimming; this is good to improve and maintain ROM and to increase and/or maintain strength, with minimal stress on weight-bearing joints.

5.4 Rehabilitation.

5.4.1 Therapeutic Unit 1; Tuesday 05.02.08.

1st session: Initial Kinesiological Examination.

Examination:

(See "Initial Kinesiological Examination")

Therapy:

-Mobilisation of blockages in interphalangeal joints of left 4th and 5th toes.

-Mobilisation of blockages in interphalangeal joints of right 3rd toe.

Results:

-Blockages released.

2nd session: Strengthening exercises.

1-"*Overball under heel 1*": Patient is supine, with both lower limbs lying extended on the table. Placing an overball under one of the patient's heels, patient is asked to press the ball towards the bench and hold the foot at the same place throughout the exercise, while the examiner continuously pushes the foot from side to side, trying to bring the patient's foot out of balance. The exercise is done on both feet, and is designed to activate many muscles, from the trunk down to the toes, to make them work together. 2 sets, 10 repetitions; 2x10.

2-"*Overball under heel 2*": Supine on the bench, with lower limbs fully extended, an overball is placed under the heel, and the patient is asked to press it into the bench. This to activate more gluteus maximus. 2x10.

3-"*Overball under knee*": Supine on the bench, lower limbs extended, an overball is placed under the knee, and the patient is told to press the ball into the bench. This to activate more the hamstrings. 2x10.

4-"*Overball between knees*": Patient supine, with hip and knee F, with overball between the knees. Patient is asked to extend one knee at the time. This exercise will activate hip adductors and knee extensors. 2x10.

4-To activate hip abductors, patient is asked to lie on her side, while lifting the upper lower limb towards the roof, as high as possible. Patient has no problem lying on her dx side, but complains of pain when lying on her sin side, telling the therapist to not forget she had replaced her sin hip. That was 7 years ago...! Exercise is terminated. Another exercise for hip abductors has to be employed.

5.4.2. Therapeutic Unit 2; Wednesday 06.02.08.

1st session: Stretching.

Examination:

-Hip F w/knee F:

-Right 90°.

-Left 100°.

-Knee F right: 80°, w/pain.

Therapy:

-Lewit PIR on rectus femoris.

Results:

-Right knee F increased to 85°.

2nd session: Strengthening exercises.

-Muscle strengthening exercises as the day before, plus one new exercise.

1-"*Pure abduction*": While lying supine I simply ask the patient to spread her legs to the side as far as possible. 2x15.

5.4.3 Therapeutic Unit 3; Thursday 07.02.08.

1st session:

Examination:

-Hip F w/knee F:

-Right 90°.

-Left 100°.

-Right knee F: 90°.

Therapy:

-Lewit PIR for rectus femoris.

Results:

-Right knee F increased to 95°.

2nd session: Strengthening exercises.

-Strengthening exercises like yesterday.

5.4.4 Therapeutic Unit 4; Friday 08.02.08.

1st session:

Examination:

-Right hip F w/knee F: 115°.

-Left: Not performed, as patient reports pain in the hip during the test.

-Right knee F: 80°. Decreased 15° since yesterday, but this may be because the patient removed the stitches earlier today.

Therapy:

-Lewit PIR for rectus femoris in modified position, with the foot hanging outside the table to THE SIDE OF THE TABLE, not at the end of the table, so as to stretch tight hip adductors as well.

Results:

-Right knee F increased to 85°.

2nd session: Strengthening exercises.

-Slight changes in strengthening exercises today.

1-"*Overball under heel 1*".

2-"*Overball under heel 2*".

2-"*Overball between knees*".

3-"*Bridges*": In supine lying, with flexion in hips and knees, with soles of feet firmly planted on the bench, patient is asked to push the pelvis towards the ceiling. 3x3, with a 3 second count in the top position.

4-"*Hip Abduction*": In a supine position on the bench, with a yellow coloured TheraBand tied around the knees, patient is asked to do hip abduction. 2x10. Patient complains of pain in the left hip.

5.4.5 Therapeutic Unit 5; Monday 11.02.08.

1st session:

Examination:

ROM:

-Right knee F 90°.

-Right patella:

-Movable, but less so in medial direction.

-Caudal direction impossible.

Scar:

-Scar has some residue of coagulated blood where the stitches used to be.

-Scar is 20 cm long.

-Scar itself is pink, with slight redness around.

-No pain on movement of scar, nor on any palpation.

-Minor swelling.

-Scar does not restrict knee ROM.

-Both knees are fairly warm.

-Scar is movable from mid-patella and 5 cm cranially.

-Upper 5 cm and lower 10 cm is very restricted, but less so in lateral direction.

Therapy:

-Lewit PIR in modified position for rectus femoris.

-10 minutes with various techniques to improve scar mobility.

Results:

-No increase in knee ROM.

Autotherapy:

-Patient is instructed in scar mobilisation techniques.

-Patient is instructed in gravity-induced PIR for rectus femoris according to Lewit.

2nd session: Strengthening exercises.

-Muscle strengthening regime as Friday the 8th of February.

5.4.6 Therapeutic Unit 6; Tuesday 12.02.08.

1st session:

Examination:

-Scar mobility as yesterday.

-Dx knee F 90°.

Therapy:

-Scar therapy as yesterday.

-Lewit PIR in modified position for rectus femoris.

Results:

-No result of the PIR today. I begin to question its effectiveness, as we've only increased the ROM by 10° in 5 sessions, plus the passive stretching machine. The patient is very afraid of her knee, she is still very afraid of loading the hip she replaced 8 years ago, so I have my supervisor tell the patient to not be so afraid, and put more trust in her therapist's ability to judge her capabilities.

2nd session: Strengthening exercises.

-Slight changes in muscle strengthening program. Exercises as before, with some additions.

1-"*Hip extension*": While in prone position on the bench, patient is asked to first flex one knee to about 90, then lift the knee off the table (hip E). This to activate hamstrings and gluteus maximus. Patient does 3 sets, with 8, 6 and 4 repetitions; 3x8-6-4.

2-"*Heel to buttocks*": While supine on the bench, with lower limbs extended, patient is told to pull one heel towards the buttocks, then down again. 2x15 on each leg. To activate knee flexors.

3-"*Circles*": While in supine position, patient is asked to perform circles with her heel on the table, as far up towards the buttocks as possible. 2x15.

5.4.7 Therapeutic Unit 7; Wednesday 13.02.08.

1st session:

Examination:

Scar:

-Right knee is still much warmer than the sin knee.

-No pain on palpation.

-Slight bumps of swelled tissue surrounding the scar.

-Redness has disappeared.

-No restriction of knee function due to scar.

-Upper 4th of the scar has improved its mobility since yesterday.

-Middle third of scar is still very movable.

-Lower third of scar is still almost not moving, but more so in lateral direction.

ROM:

-Right knee F is still only 90°, after 5 sessions with Lewit PIR, and with the patient's assurance that she's been doing gravity-induced PIR in her bed at least once per day, as well as having CPM for at least 30 minutes daily, therapy for increasing ROM of right knee into F seems not to be working. Something is not correct. The therapist decides to try to make rectus femoris tired before doing PIR next time.

-When therapist passively flexes the patient's knee, she reports minor pain. The therapist so far assumed it was in the knee, but when asked, the patient locates the pain to the attachment points of medial and lateral hamstring muscles. Pain inside the knee occurs first when passively flexing the knee 5° beyond this initial pain.

Therapy:

-Scar therapy as before, but focusing on the lower third.

-Strengthening of quadriceps femoris:

1-"*Heel to buttocks*". 2x10.

2-"*Flip Flap*". 2x20.

3-"*Overball under knee 2*": In supine position on the bench, an overball is put under patient's knee, and patient is asked to extend the knee. Therapist applies resistance.

-Lewit PIR in modified position for rectus femoris. Doing this, patient reports pain in the hip adductors.

-Lewit PIR for adductors; as patient is not fully able to get into the position according to Lewit because

of the restricted ROM in her dx knee, a modified position is called for: Patient does as much abduction, external rotation and flexion as possible. The therapist's hand is placed on the medial aspect of the knee, the patient is told to press against, breathe in and hold her breath. The therapist notices that the patient quietly breathes out when she should be holding her breath. Maybe the language barrier (the therapist and the patient not sharing a common language) is the reason why Lewit PIR is not working? Patient is again told to press against therapist's hand, breathe in and hold her breathe AND DON'T BREATHE OUT!, and then after 10 seconds breathe out and relax for twice the time. This is repeated 4 times.

-Again, Lewit PIR for rectus femoris in modified position, telling the patient DO NOT BREATHE OUT during the muscle activation phase.

Results:

-Right knee F increase with 5°, to a total of 95°.

2nd session: Strengthening exercises.

Focus on hamstrings and gluteus maximus.

1-"*Bridges*". 5x3, with 5 second count at top position.

2-"*TheraBand Abduction*". Red TheraBand around the knees, doing hip ABD. No pain. 2x10.

3-"*Hip extension*". 3x10.

5.4.8 Therapeutic Unit 8; Thursday 14.02.08.

1st session:

Examination:

-Scar:

-As before.

-ROM:

-About 95°, but it is much easier for patient to relax when the therapist asks her to.

Therapy:

-Scar therapy as before.

-Lewit PIR for hip adductors in modified position.

-Lewit PIR in modified position for rectus femoris.

Results:

-Results: 5° increase, and decreased muscle tone of quadriceps.

2nd session: Strengthening exercises.

1-"*TheraBand kicking*": In a supine position, the patient hold one end of a TheraBand in her hands, while the other end is tied around her feet. Exercise was done with both feet at the time, with one foot at the time and the other stationary, and with one foot going up, the other down. 2x20 with each colour (yellow and red).

2-"*TheraBand abduction*": In a supine position, red and green TheraBands are tied around the patient's feet, and the patient told to do hip abduction. 2x15 with each colour.

3-"*Bridges*": As before.

5.4.9 Therapeutic Unit 9; Friday 15.02.08.

1st session: Scar therapy and stretching.

Therapy:

-Scar techniques.

-Lewit PIR in modified position for rectus femoris.

Results:

-Range of motion in knee increases from 100° to 110°.

2nd session: Final kinesiological exam.

5.5 Final kinesiological examination.

5.5.1 Postural Examination.

As the patient is still not allowed to put much weight on her operated knee, short-term rehabilitation has not worked specifically on correcting any postural faults. Thus, standing posture has not improved significantly since the Initial Kinesiological Examination.

Findings from Initial Kinesiological Examination were as follows:

Posterior view:

-Slight rotation in both subtalar joints, more on the left.

-Right popliteal line indicates internal rotation of the right hip.

-Valgosity of both extremities, more marked on the left limb.

-Elevation of right shoulder.

Anterior view:

-Increased lateral rotation of the right foot.

Side view:

-Similar findings from both left and right view.

-She has difficulties standing without supporting herself with her hand on the wall.

-Load mainly on left lower limb.

-Left flat foot and pronation.

-No hallux valgus, neither right nor left.

-Right/Left 2nd toe claw toes.

-Semiflexion in the right knee.

-Trunk is displaced anteriorly and rotated to the right, i. e., trunk and hip F, trunk R.

-Protruding abdomen.

-Hyperlordosis of lumbar spine.

-Decreased kyphosis of lower thoracic spine.

-Increased kyphosis of upper thoracic spine.

-Protraction of both shoulders.

-Decreased cervical lordosis.

5.5.2 Gait Examination.

Though it is not included in the description of rehabilitation, for every session (two daily), the therapist went to the patient's room in the 1st floor and walked with the patient down to the Ground floor for therapy, and after the therapy session, walked the patient back again. During this time, the therapist encouraged the patient to "walk proud", "walk like a queen" and similar. This has proven to yield significant results.

Gait (with crutches) has improved. The patient is now able to walk with a much more erect posture, involving the hip extensors more in the propulsive phase of the gait, and relying less on elevation of the shoulder girdle to move crutches forward.

5.5.3 Muscle Strength Examination.

Right	Muscle group	Left
4+	Knee extensors	4+
3	Hip abductors	3
4	Hip flexors	4
4	Hip adductors	4
3+	Gluteus maximus	3+
3+	Biceps femoris	3+
3+	Semitendinosus/ Semimembranosus	3+

Table 6: Muscle Strength After Therapy (8).

5.5.4 Muscle Length Examination.

Right	Muscle(s)	Left
OK*	1-joint hip flexors	OK*
short, 30**	2-joint hip flexors	short, 20**
OK*	Ankle plantarflexors	OK*
OK*	Ankle dorsiflexors	OK*
OK*	Hip abductors	OK*
OK*	Hip adductors	OK*
OK*	Knee flexors	OK*

Table 7: Muscle Length After Therapy (8).

*No length deficiency.

**Degrees of knee extension occurring, from a position of 90 knee F.

5.5.5 Range of Motion.

dx	Movement	sin
135	Hip F	100
10-15	Hip E	10-15
45	Hip ABD	45
10	Hip ADD	10
45	Hip ER	45
45	Hip IR	45
110	Knee F	135
0	Knee E	0
45	Ankle PF	45
20	Ankle DF	20

Table 8: ROM After Therapy (8).

5.5.6 Therapy Effect Evaluation.

Patient has improved the ROM of her right knee into flexion with 30°, from 80° with some pain and hypertonic quadriceps musculature, to 110° with minimal pain and normotonus.

Gait (with crutches) has improved. The patient is now able to walk with a more erect posture, including the hip extensors more in the propulsive phase of the gait, and relying less on elevation of the shoulder girdle to move crutches forward.

Standing posture has had no improvement.

Patient is not so afraid anymore to move her right knee.

5.5.7 Prognosis.

So far there has been no complications, neither with surgery, nor with therapy, if you exclude the slow progress of increase in right knee ROM into F. Patient shows a great interest in improvement, and is not satisfied with her current right knee ROM.

However, she will now go home to her own house, and no physiotherapy will be given, unless she pays for a therapist herself. Which she probably will not do, as it costs money, and she is capable of most ADL already.

Normally, a patient with a total knee replacement, will walk with axillary crutches for maximally 6 months. It is up to the patient's medical doctor to decide for exactly how long. At the time, she is only allowed to touch the ground with her right foot, she is under no circumstances allowed to put full body weight on it. The next orthopaedic control is 3 months after surgery, that is, in the end of May or beginning of June. The orthopaedician will then decide how her rehabilitation has been so far, and how much she can now load her foot. Maybe she will also change to elbow crutches, or leave them altogether.

5.6 Conclusion.

The second day of my two-week practice period, I was given a list of prospective patients; spondyloarthrosis, hip replacements, various connective tissue disorders and one total knee replacement. Up to that point, I've never had any experience with a patient after total knee replacement, so I choose that one. I did the Initial Kinesiological Examination based on my own intuition and general knowledge in the field of rehabilitation, and started working. I produced results on the area of my rehabilitational focus (improving range of motion of the right knee into flexion), and as such, I am satisfied with the results.

The only drawback to the practice that I might have, is the fact that we were at the clinic for only two weeks, and had to take the kind of patients we were given. Some of my fellow students were not so lucky as me; some had to wait until the fourth day of their practice to receive a patient to base their thesis on, some "lost" their patient and had to find a new one (the patient was sent home from the hospital without the student knowing about it beforehand), and some had only a total of 4 hours with the patient during these two weeks. This creates a lot of undue stress, and is an area of improvement, regarding the clinical practice as such.

A note has to be written about "missing" examinations; As we have only a limited time with the patient, but an almost endless arsenal of examination and treatment tools available taught us during these 3 years at FTVS, one has to prioritize. Therefore, one will not find Anthropometric Measurements, Neurological Examinations nor Janda's Basic Movement Patterns.

A complete neurological assessment was done by a medical doctor upon hospitalization to Revmatologicky Ustav, revealing no neurological deficits.

I did not do examination of Anthropometric Measurements, as the patient's medical documentation stated that a slight length deficiency between the patient's lower limb was corrected through the replacement surgery. Also, possible findings of thigh circumference measurement might possibly reveal the degree of muscle wasting, but I felt that the examination of muscle strength would reveal more interesting findings.

The only examination that I can not defend not having done, is Janda's Basic Movement Patterns, especially the hip abduction test, taking into consideration the patient had a total hip replacement sin. L. performed in 2000. This I simply forgot to do, and will have to include should I again encounter a patient requiring rehabilitation of a replaced knee, and other locomotor dysfunctions.

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7. Supplements.

7.1 UK FTVS Ethics Committee.

7.1 UK FTVS Ethics Committee.

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Application for
Opinion of UK FTVS Ethic Committee

On the project of Bachelor Thesis including human participants

Title: Osteoarthritis, total knee replacement and its rehabilitation.

Project form: Bachelor Thesis

Author: Øystein Grønnevik.

Supervisor Mgr. Jirina Holubarova.

Project description

The case report of rehabilitation the patient with anamnesis Osteoarthritis elaborated with the vocational sight of physiotherapist in Revmatologicky Ustav.

No one invasive procedure will be applied.

Proposal of Agreement (enclosed)

Prague April, 2008. Author's signature Øystein Grønnevik

Statement
UK FTVS Ethic Committee

Committee members: Ass. Prof. Staša Bartůňková, M.D., CSc.
Prof. Ing. Václav Bunc, CSc.
Prof. PhDr. Pavel Slepička, DrSc
Ass. Prof. Jan Heller, MD., CSc.

The project was authorized by Ethic Committee UK FTVS with reference number: 0109/2008

Date: 10. 4. 2008

Ethic Committee UK FTVS evaluated submitted project and found no discrepancy to valid principles, instructions and international guidelines for biomedical research, including human participants.

Author of project fulfilled necessary conditions for the agreement of Ethic Committee.

Faculty stamp

Signature of EC chairman

Univerzita Karlova v Praze
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-5-

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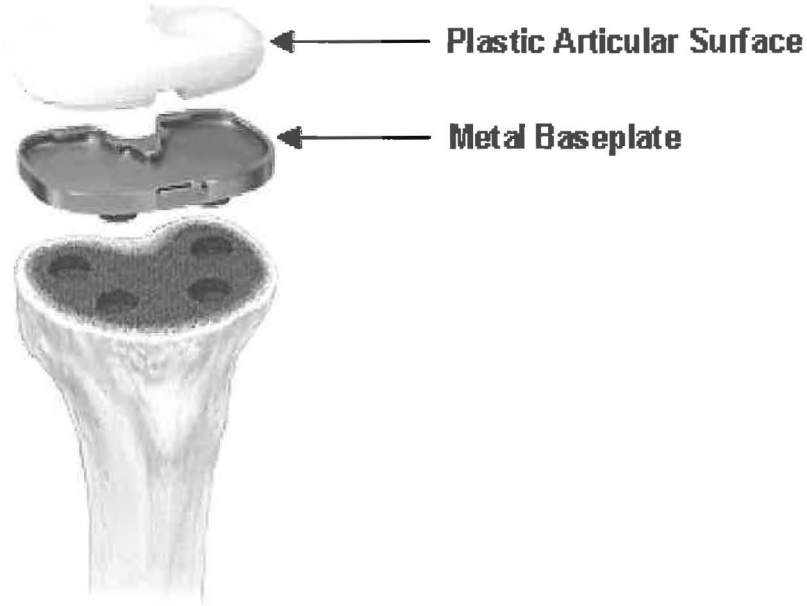
7.2 Surgery.

7.2.1 Picture 3: Prepping.

7.2.2 Picture 4: Femoral Replacement.

7.2.3 Picture 5: Tibial Replacement.



7.2.4 Picture 6: Patellar Replacement.

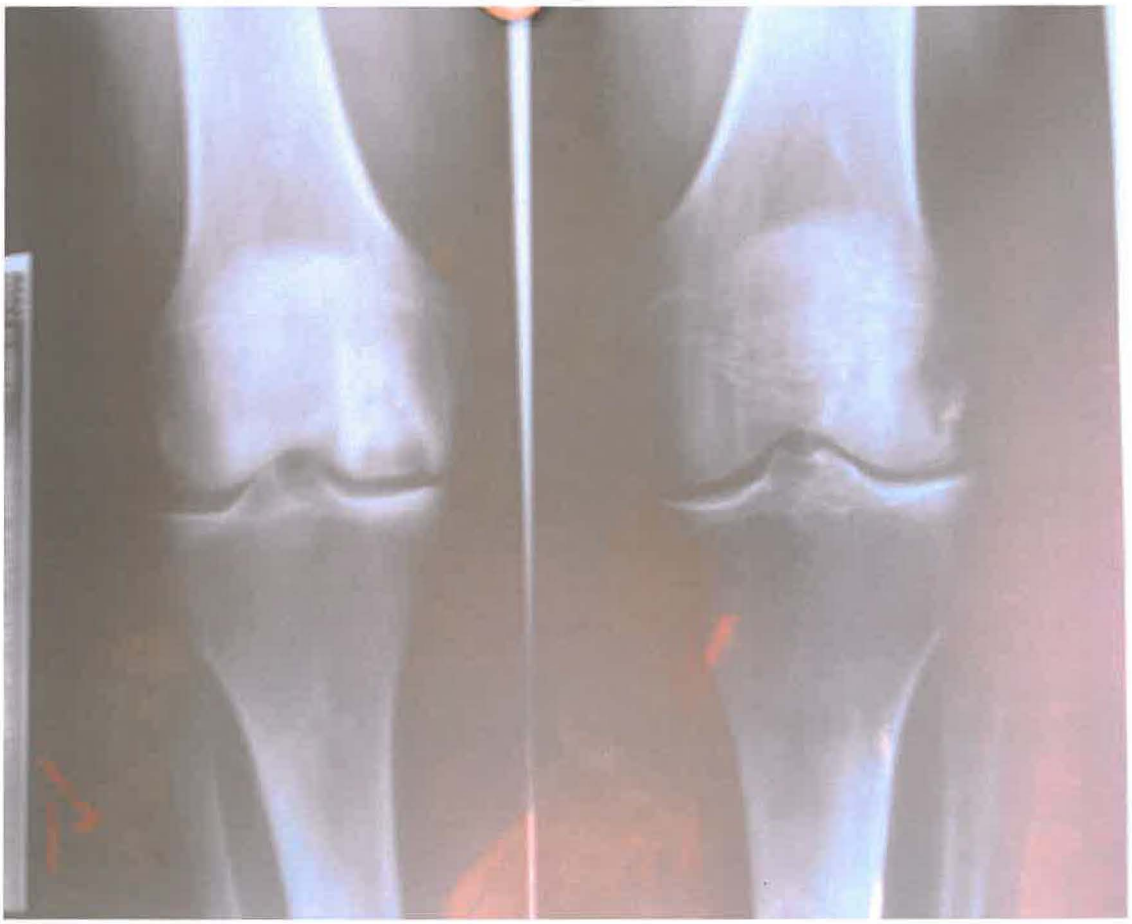
7.2.5 Picture 7: Replacements with pegs or stem.

Implants with Pegged Design

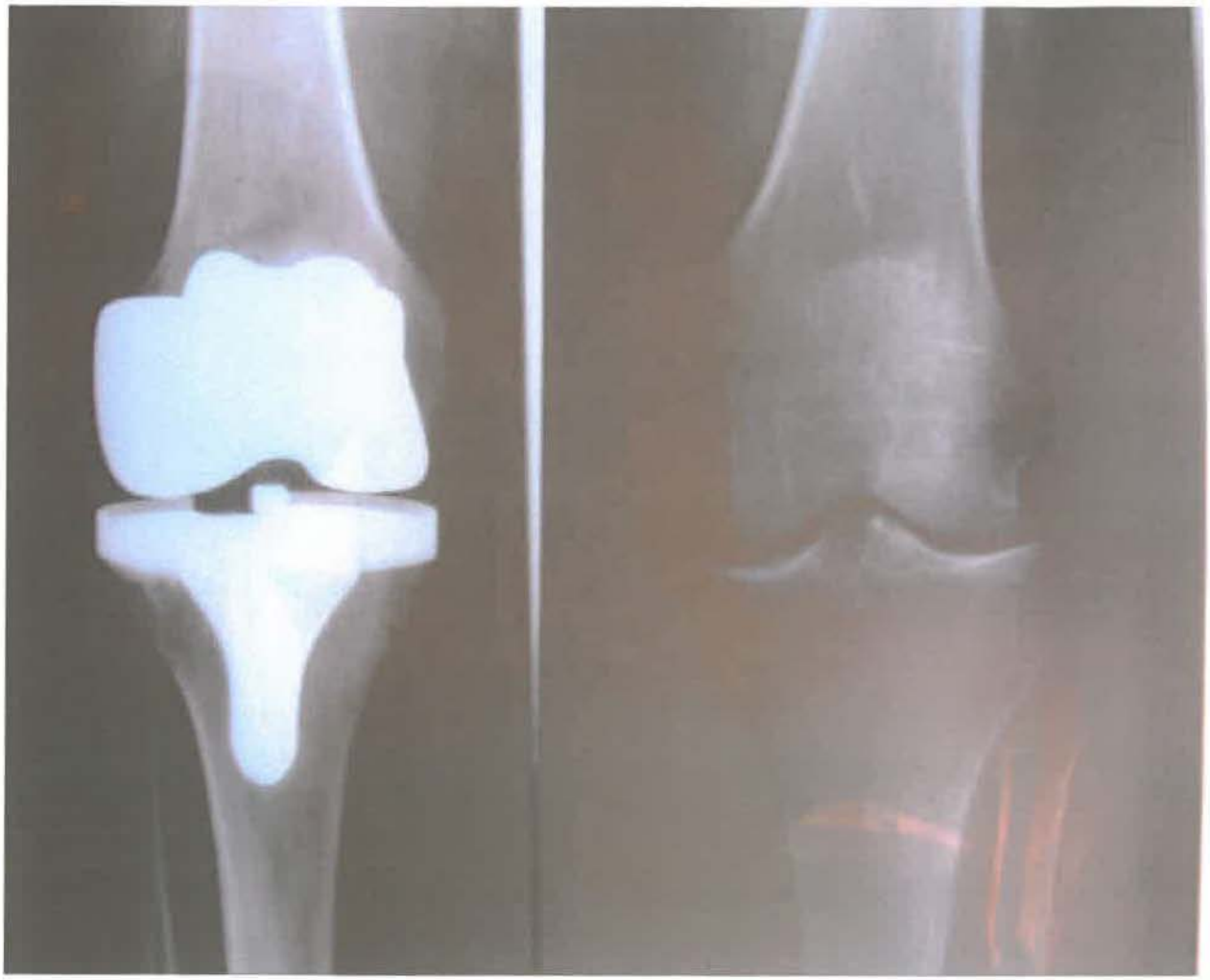
Implants with Stemmed Design

7.3 X-rays.

7.3.1 Picture 8: Knees before replacement.



7.3.2 Picture 9: Knees after replacement.



7.3.3 Picture 10: Knees after replacement, side view.

7.4 Postural pictures.

7.4.1 Picture 11: Posterior view.

7.4.2 Picture 12: Anterior view.

7.4.3 Picture 13: Right side view.

7.4.4 Picture 14: Left side view.